

**Electron-beam induced carbon patterns used as mask for the cadmium sulfide deposition on Si(100)**

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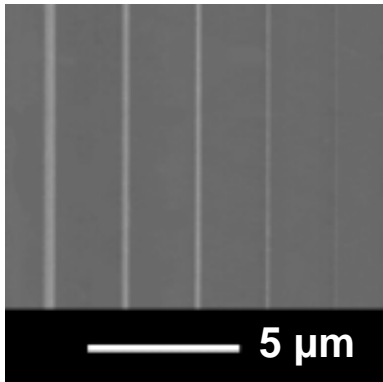
Micro- and nanometer scale pattern generation on semiconductors plays a crucial role in the field of semiconductor technology requiring shrinkage of dimensions in integrated circuits. To achieve sub- $\mu\text{m}$  resolution a wide range of processes have been studied including e-beam lithography mainly used to fabricate photolithographic masks and ultrasmall metal linewidths on semiconductor surfaces.

Electron-beam induced carbon deposition, using the residual hydrocarbon molecules issued from the pump oil in scanning electron microscope (SEM) chambers, has recently been used for a variety of nanotechnological applications. Previous own work has explored possibilities to use C-masks produced by contamination writing in a SEM to suppress selectively metal deposition at treated surface locations providing the basis for a novel patterning method in the nanometer range [1]. It has been demonstrated that such diamond like carbon deposits in the order of 1 nm thickness can be sufficient to achieve a negative resis effect, *i.e.*: can block the electrodeposition of gold completely selectively [2].

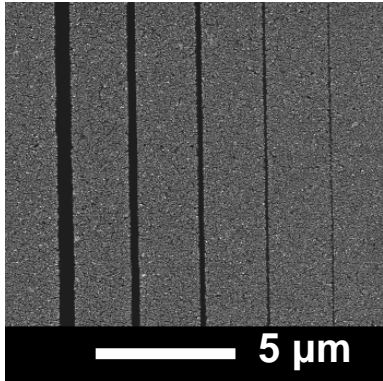
In the present work we explore the possibility to use the C-masks for selective CdS deposition. In order to fabricate optoelectronic devices and solar cells CdS deposition has been the subject of a large number of electrochemical investigations. Here we use electrochemical CdS deposition on a C-patterned silicon surface to demonstrate the efficiency of the negative mask effect due to the carbonaceous deposits. Carbon patterns were written at different electron doses on n-type Si(100) surfaces and characterized by atomic force microscopy (AFM) and Auger Electron Spectroscopy (AES). Subsequently, Cd was electrochemically deposited from a 1 mM  $\text{CdF}_2 + 0.05 \text{ M NaF}$  electrolyte and converted into CdS by a chemical treatment in a 1 M  $\text{Na}_2\text{S}$  solution. The deposits were characterized by SEM, AES and photoluminescence measurement. We demonstrate that the lateral resolution and the degree of selectivity depend on several factors such as the electron dose during masking and the electrochemical parameters used for deposition.

**References:**

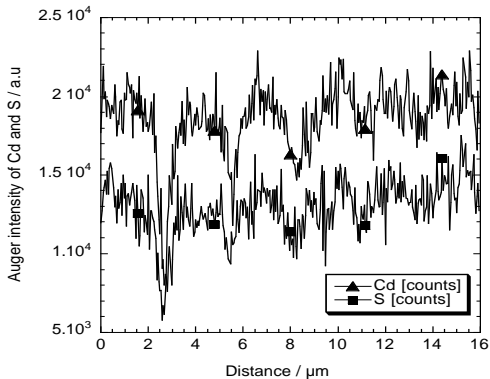
[1] T. Djenizian, L. Santinacci and P. Schmuki, *Appl. Phys. Lett.*, in Press, 2001.  
[2] T. Djenizian, L. Santinacci and P. Schmuki, *J. Electrochem. Soc.*, **148**, C197 (2001).



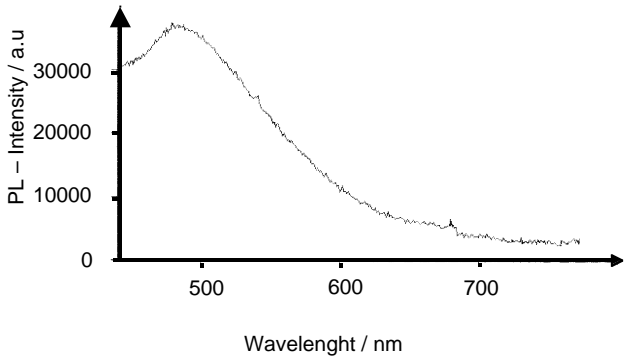
**Fig.1:** AFM top view of an array of five contamination lines e-beam deposited on silicon with 300, 180, 120, 60 and 30 s exposure time (the exposure time decreases from the left to the right).



**Fig.2:** SEM image of CdS deposit on Si surface carrying the C-lines pattern of Fig.1. CdS deposition was carried out in 1 mM  $\text{CdF}_2 + 0.05 \text{ M NaF}$  by potential steps to  $-1.45 \text{ V}$  for 7 min, followed by a chemical treatment in a 1 M  $\text{Na}_2\text{S}$  solution.



**Fig.3:** AES line scan across the lines of Fig.2 for Cadmium and Sulfur.



**Fig.4:** Photoluminescence spectrum taken from Fig.2, measured at room temperature. A wide peak between 490 and 570 nm, typical for CdS, is observed.